

The minimum 1/2-inch heavy-duty, reversible electric drill with a torque limiter shall operate on 240 volts. A means of checking the restraint offered by the torque limiter shall be provided.

The drill shall be provided with overload protection and be UL approved. The drill shall be arranged for remote control operation. A drill mounting assembly shall be easily attached to the base of the pole with a quick-connect securing mechanism that can accommodate any size or shape pole. A pendant control switch with a 20 foot cord shall be provided to allow the operator to stand clear of the service area while the luminaire ring is either raised or lowered. Two drills shall be provided.

8.

TABLE IA
Construction, Physical Properties of Galvanized Carbon Steel
and Stainless Steel Wire Rope

Nominal Dia. of Wire Rope (In.)	* Const.	Tolerance on Dia. (Plus only) (In.)	Allowable Inc. of Dia. (In.)	Nominal Break Strength Galv. Carbon Steel (Lbs.)	Nominal Break Strength Stainless Steel (Lbs.)	Approx. Wt. per 100 ft. (Lbs.)
5/32	7 x 19	.016	.017	2,800	2,400	4.50
3/16	7 x 19	.018	.019	4,200	3,700	6.50
7/32	7 x 19	.018	.020	5,600	5,000	8.60
1/4	7 x 19	.018	.021	7,000	6,400	11.00
5/16	7 x 19	.022	.024	9,800	9,000	17.30
3/8	7 x 19	.026	.027	14,000	12,000	24.30

*See Section 895.14 H.5.c.(5)

9.

TABLE IB
Construction and Dimensional Properties of
Nylon Jacketed Wire/Rope Jacket Tolerances

Nominal Dia. of Wire Rope (In.)	* Const.	Tolerance on Jacket O.D. (Plus only) (In.)	Outside Dia. of Jacket (In.)	Jacket Wall Thickness (Reference) (Lbs.)	Approx. Wt. per 100 ft. (Lbs.)
3/16	7 x 19	.022	5/16	.063	9.20
7/32	7 x 19	.020	9/32	.031	9.76

*See Section 895.14 H.5.c.(6)(c)

SECTION 896

HIGHWAY TRAFFIC SIGNALS

896.01 GENERAL.

The word and phrase definitions shall be as defined in Section 1 "Definitions" of NEMA Standards Publication TS 2 latest edition *Traffic Control Assemblies with NTCIP Requirements*.

These Specifications shall not be considered as requiring one manufacturer's equipment over any other, provided suitable interchangeability is preserved for maintenance purposes and equal quality, reliability, and durability can be expected in performance.

The word and phrase definitions shall be as defined in Part 1 "Definitions" of NEMA Standards Publication TS-1 latest edition *Traffic Control Systems*.

The Contractor shall furnish the specified material unless substitute materials are approved in writing by the Engineer.

All hardware and software shall process dates and date-related data accurately prior to, during and after the year 2000. This will include accurately inputting, storing, manipulating, comparing, calculating, updating, recording, displaying, outputting and transferring such dates and data.

896.02 RIGID CONDUIT.

- A. **Steel Conduit.** Steel conduit shall be of corrosive-resistant material meeting UL 6. Aluminum conduit shall not be used.
- B. **Polyvinyl Chloride Conduit.** Rigid nonmetallic conduit shall be a polyvinyl chloride (heavy wall) conduit meeting UL 651 suitable for direct burial applications.

896.03 CONDUCTORS.

- A. **Feeders.** Conductors used as feeders shall be one of 2 types: a single-stranded conductor or multiple-stranded conductors formed into a cable. The underground phase and neutral conductors shall be insulated to meet the requirements for direct burial cable carrying currents of up to 600 volts, and shall meet ASTM B-3 and B-8. Aluminum conductors shall not be used.

Single conductor shall be marked Style "RHW-USE" with the required AWG size on the sheath. The grounding conductor (not a neutral) shall be stranded No. 6-AWG-Type THW. Rubber insulation specifically listed for that purpose by the Underwriter Laboratories does not require an outer cover.

- B. **Loop and Loop Lead-In Conductor.** The conductor shall meet one of the following:
 1. The copper loop conductor shall be No. 14 AWG, Type XHHW or THWN or THHN single-stranded 600 V conductor or as recommended by the detector manufacturer.
 2. Polyethylene Conduit Pre-wired shall consist of a pliable polyethylene conduit with No. 14 AWG stranded copper Type XHHW or THWN or THHN 600 V conductors. The conductors shall be factory assembled in a continuous flexible polyethylene conduit. The conduit shall be constructed from 1/4-inch black polyethylene meeting ASTM D-1248, Type III, Grade P33 or E10, Category 5, Class C, and shall be certified to meet or exceed the following values:

**NOMINAL DIMENSIONS OF
POLYETHYLENE CONDUIT IN INCHES**

Duct Size	.250
Outside Diameter	.250 ± .010
Wall Thickness	.032 ± .010
Nominal Inside Diameter	.185
Minimal Bending Radius	1.00

**NOMINAL PHYSICAL PROPERTIES OF
POLYETHYLENE CONDUIT**

Property	Test Value	ASTM Test
Tensile Strength @ yield, psi	3,200 min.	D-638
Ultimate Elongation, %	400 min.	D-638
Melt Index, gms/10 min.	0.5 max	D-1238
Carbon Black Content, %	2.00-3.00	D-1603
Density of Base Resin, gms/cc.	0.941-0.959	D-1505
Brittleness Temperature, F ₂₀	-75°C., max.	D-746
Environmental Stress Crack Resistance, F ₂₀	48 hrs.	D-1693 Cond. B

The conduit shall also meet or exceed the performance tests as specified in NEMA Standards Publication No. TC7, Part 3 as follows:

- a. TC7-3.01 Compressions and Recovery
- b. TC7-3.02 Impact Test

The conduit shall be permanently marked on the outside at regular intervals with the manufacturer's name, trademark, nominal conduit diameter, Type III, and year of manufacture.

- 3. The copper loop lead-in conductor shall be a No. 14 AWG stranded polyethylene insulated twisted pair with a foil shield or as recommended by the detector manufacturer, and shall be able to be placed in a common conduit with power and control circuit cable without interference.

The jacket shall be a Hi density polyethylene jacket with a nominal thickness of 0.032 inches.

- 4. **Preformed Loop Detector.** The Performed Loop Detector shall be constructed of PVC and loop conductor. The loop detector shall be totally encased in 1/2" schedule 40 PVC, (sprinkler pipe, heavy wall construction) with pipe fittings and glue. One corner shall be terminated with a 1/2" PVC tee fitting to provide an exit to the pull box conduit. The PVC is to be sealed at the joints with water pipe fitting glue to prevent water entrenchment. The conductor shall be No. 14 AWG, Type XHHW or THHN or THWN, 600 V stranded single conductor. The loop shall be constructed from a continuous piece of conductor with no splices throughout the entire length to the pull box. Three turns shall be placed in the preformed loop. The conductor from

the loop to the pull box shall be twisted to provide a minimum of two to five turns per foot.

5. **Microloop Probe:** The microloop probe shall be a small, cylindrical, passive transducer of earth's vertical magnetic field intensity into inductance. It transforms changes in magnetic field intensity into inductance changes which can be sensed by loop detector units. Probes shall fit vertically in 1" holes and lead-in cable in 3/8" saw slot or in sand in the roadway base. Micro-loop probes can be connected in series with other microloop probes or conventional wire loops. The microloop probe shall operate under the following parameters: Earth's Vertical Magnetic Field (0.2 to 1.0 oersted), Inductance (20 microhenries to 25 microhenries per probe plus 20 microhenries per 100' of wire), DC Resistance (0.5 ohms per probe plus 3.2 ohms per 100' of wire) Transducer Gain (typically 3.5 microhenries per oersted at 0.4 OE ambient vertical field intensity), and Sensitivity with 2 probes (7.0 microhenries per oersted at 0.4 OE ambient vertical field intensity). The microloop probes shall operate at a temperature range of -35°F to +165°F (-37°C to +74°C) and at humidity of 0 to 100%. The microloop probes shall detect all motorized vehicles.

- C. **Traffic Signal and Flashing Beacon Control Circuits.** The cable required for the signal control circuits shall consist of No. 12 AWG multiple conductor cable. The Pedestrian push button circuit shall consist of No. 16 AWG multiple conductor cable. The cables shall be rated for 600 volts and meet NEMA Standard Publication WC-5.

The conductor shall be Class B or Class C stranded copper, and the insulation shall be polyvinyl chloride or polyethylene. The thermoplastic insulation over the individual conductors shall consist of a minimum thickness of 30 mils, of which a minimum of 20 mils shall be polyethylene and the remaining thickness either polyvinyl chloride or extruded nylon. Where cable has been approved as THWN/THHN conductor, the conductor and the thermoplastic insulation over the individual conductors shall consist of a minimum thickness of 19 mils, of which a minimum of 15 mils shall be polyvinyl chloride with the remaining thickness of nylon.

Circuit and cable identification, cable fillers, and binders shall meet Part 5 of NEMA WC-5, except as modified here. The color coding of conductors shall meet Appendix K, Method I, Table K-1 of NEMA WC-5. All fillers shall be of a moisture-resistant material, and shall not be jute. Binder tapes shall be of a moisture-resistant material.

The jacket shall be polyvinyl chloride with the thickness meeting Table 7.4.2, NEMA WC-5.

896.04 PULL BOX.

Concrete pull boxes shall meet Section 895.04.

896.05 SAW SLOT SEALANT.

The joint sealer shall be made of a material mixture to form a resilient and adhesive compound capable of effectively sealing the saw slot. The seal shall protect against

infiltration of moisture and foreign material throughout repeated cycles of expansion and contractions with temperature changes. Also, the sealing compound shall not flow from the joint or be picked up by vehicle tires at summer temperatures. The material shall be capable of being brought to a uniform pouring consistency for completely filling the saw slot without large air holes or discontinuities and without damaging the material. An epoxy-type sealant will not be permitted.

896.06 FEED POINTS.

A. **Traffic Signal.** A traffic signal feed point shall also include:

1. A 60 amp size switch box.
2. One manually operated weatherproof switch, 2 pole, single throw, 125/250 volt with 45 ampere cartridge fuses, or breakers.

B. **Flashing Beacon.** A flashing beacon feed point shall also include:

1. A 60 amp size switch box.
2. One manually operated weatherproof switch, 2 pole, single throw, 125/250 volt with 15 ampere cartridge fuses, or breakers.
3. Both a Radio Interference Filter (RIF) and a Surge Voltage Protector (SVP) shall be supplied for use on the 120 VAC supply. Each shall be rated at nominal 120 volts, 60 Hz., and a minimum of 30 amps and in no case be less than the current rating of the circuit breaker protecting it. There may be one RIF and one SVP protected by a common main circuit breaker before the 120 VAC supply is split into the automatic and flash circuit breaker branch circuits, or a separate RIF and SVP may be used after each pole of the automatic and flash circuit breakers.
4. The flasher shall be solid state and meet NEMA Standards Publication No. TS 2, latest edition, Traffic Controller Assemblies with NTCIP Requirements, Section 6.
5. Where the flashing beacon is to be a school crossing beacon, a solid state time clock shall be installed. The solid state time clock shall have, as a minimum, the following capabilities:
 - a. Automatic daylight savings time and leap year compensation.
 - b. A minimum of 48-hour battery or capacitive backup-memory and timing maintained in event of power loss.
 - c. A minimum of 6 program steps programmable to one-minute intervals.
 - d. Operate on a line voltage of 95–135 Volts AC, 60 Hz.
 - e. Temperature range of –30 °C to +74 °C.
 - f. Liquid crystal display.
 - g. Single Pole, Double Throw (SPDT) output relay rated 10 Amp, 115 Volt AC resistive load.

- h. Terminal block for electrical connection that will accommodate wire sizes #16 – #12 AWG.
- 6. A weatherproof cabinet with a lock and 2 keys shall be of adequate size to mount circuit breakers, on-off switch, flasher, time clock (if required), and all necessary wiring. This cabinet is not required when the Plans specify that the flasher shall be placed in a feed point cabinet.

896.07 TRAFFIC SIGNAL STANDARDS.

A. **General.** The design of the Traffic Signal Standards shall meet the requirements of AASHTO publication, *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (1994). A wind velocity of 85 mph with the necessary coefficient of height correction factor shall be used in the calculations. The wind loads, allowable stresses, etc., shall meet these Specifications. Different wind pressures shall be applied to the structures at different heights, rather than using an average wind pressure for the entire height of the structures. All necessary calculations and drawings used in the design of these standards shall be furnished with the shop drawing submittal. The support structure shall be designed to support the mast arm signals and signs, if required.

B. Type I and II Standards.

1. **Shaft.** The shaft shall be made of standard steel seamless pipe meeting AASHTO M-183 or ASTM A-53; or the shaft shall be made of standard aluminum pipe meeting ASTM B-429, Alloy 6061-T6, or 6063-T6. The shaft shall be 4-1/2 inches in outside diameter, with one end threaded for connection to the base. The design stresses for the shaft shall be calculated at the root of the thread.
2. **Transformer Base.** A transformer base of adequate strength, shape, and size shall be secured to the lower end of the shaft. The shaft shall be tightened securely in the base. The base shall be provided with 4 holes to receive the anchor bolts, a handhole, and a grounding lug on the inside of the shaft or base. The grounding lug shall be opposite the handhole and a locking device shall be included for the handhole cover. All details of the bases shall be well-defined and true. Design stresses shall be calculated at the root of the thread or thinnest wall section. The material shall meet ASTM A-27 Steel, or ASTM B-26, or B-108 Alloy 356-16 Aluminum. All necessary mounting hardware shall be furnished.
3. **Type I Signal Standard.** This standard shall be used to mount traffic signal controller cabinets and detector cabinets. The combined height of shaft, base, and cabinet shall be a maximum of 6 feet to the top of the cabinet.
4. **Type II Signal Standard.** This standard shall be used as the pedestal for pedestrian signals. The overall height of the shaft and base shall be 8 feet.

C. Type IV, V, VI, and VII Standards and Combination Signals and Light Standards.

1. **Shaft.** The shaft shall be round or multi-sided, made of steel that has a minimum yield strength of 48,000 psi after fabrication. The wall thickness shall

be a minimum of 0.179-inch for Types IV, V, VI, and VII shafts, and 0.239-inch for the combination light and signal shaft. The shafts shall be tapered with top and bottom diameters large enough to withstand their design load. The Type V, VI, and VII shafts shall have a top outside diameter of 4-1/2 inches for a post top slipfitter, and the combination light and signal shaft shall be 2-piece construction.

2. **Mast Arm.** The truss mast arm shall have both lower and upper members securely joined by vertical struts. These members shall have a minimum wall thickness of 0.119 inch, and shall have a minimum yield strength in excess of 48,000 psi after fabrication. The monotube mast arm shall be round or multi-sided. The mast arm shall have a minimum wall thickness of 0.179 inch, and shall have a minimum yield stress of 48,000 psi after fabrication. Only one longitudinal weld and no transverse welds shall be permitted in fabricating the mast arm. The signal mast arm shall be designed to be rotated away from the roadway without disconnecting signal circuits or removing the mast arm.
3. **Anchor Base.** The anchor base shall be a one-piece steel casting or hot-rolled carbon steel plate. The steel casting shall meet AASHTO M-103, Grade 65-35. The anchor base shall be secured to the lower end of the shaft by 2 continuous welds. One weld shall be inside the base at the bottom of the shaft, while the other shall be on the outside of the shaft at the top of the anchor base. The welded connection shall develop the full strength of the adjacent shaft section.
4. **Transformer Base.** The steel transformer base shall be the size specified by the manufacturer to support the shaft and mast arm. It shall have a yield strength in excess of 33,000 psi after fabrication. The transformer base shall be fastened to the shaft anchor base by 4 galvanized hex-head machine bolts and nuts meeting AASHTO M-164, galvanized according to AASHTO M-232. There shall be a door opening opposite the street side of the transformer base, secured in place by an approved locking device.
5. **Luminaire Extension.** The shaft extension for mounting the luminaire shall be designed the same as the rest of the shaft. The galvanized steel extension shall have a minimum wall thickness of 0.119 inch and shall have a minimum yield strength of 48,000 psi after fabrication. The extension shall be galvanized according to AASHTO M-111. The stainless steel extension shall have a minimum wall thickness of 0.721 inch and have a minimum yield strength of 60,000 psi. The stainless steel shall meet the requirements of ASTM A 666, Type 201. The shaft shall be tapered with a bottom and top diameter of sufficient size to withstand the design loads. The extension shall be designed to provide for mounting a street light luminaire at a specific height above the pavement.
6. **Miscellaneous.** Connections, brackets, banding, wiring entrances, etc., shall be according to the manufacturer's specifications. Mast arm signals shall be designed for a rigid mounting of traffic signals. All hardware used in assembling the traffic signal standard base or mast arm shall be galvanized according to AASHTO M-232. A grounding lug on the inside of the base shall be provided.

896.08 TRAFFIC SIGNAL HEADS.**A. Standard Units.**

1. **General.** The design of the signal head shall allow the addition of a signal section with the aid of simple tools and the addition of certain standard parts. All signal heads, lamps or a light-source using Light Emitting Diodes (LED) shall conform to the latest standards of the Institute of Transportation Engineers. All exposed screws and fasteners shall be 1808, Type 304 stainless steel.
2. **Housing.** The housing of each section shall be one-piece corrosion-resistant aluminum, aluminum alloy die casting, or a one-piece polycarbonate resin material complete with integrally cast top, bottom, and sides. The polycarbonate housing shall be at least 0.090 inch thick, and shall be ribbed with at least 2 vertical ribs in addition to ribs on the top and bottom surfaces. Reinforcement plates shall be furnished and installed to reinforce the bottom of the signal head when rigidly mounted on a pedestal-type signal standard. Two sets of internal bosses shall be provided in each section for horizontal mounting for a terminal block. The top and bottom exterior shall be flat to assure perfect alignment of assembled sections. Individual signal sections shall be fastened together either with machine screws between each section or by the 3 bolt and 2 washer method. The housing door of each signal section shall be a one-piece corrosion-resistant aluminum, alloy die casting, or polycarbonate resin material.
3. **Lens.** The circular lens shall be standard Red, Yellow, Green, or special stenciled design. The polycarbonate lens shall meet ASA D-10.1, UDC 656.057 or revisions thereof. The colors of vertically mounted lens shall be positioned as specified in MUTCD. Each 8-inch lens shall have a nominal diameter of 8 inches with an outside diameter of from 8-5/16 inches to 8 3/8 inches. Each 12-inch lens shall have a nominal diameter of 12 inches with an outside diameter of from 11-15/16 inches to 12-1/32 inches.

The Contractor may choose to furnish signal heads using circular lenses using either incandescent lamps as a light source or a LED light source. He may provide a combination of signal sections using circular lenses using incandescent lamps as the light source and/or LED as a light source.

The manufacturers shall certify that the ITE specifications are met. These certifications shall be supplied with the shop drawings.

4. **Lamps.** All traffic signal lamps for use in 8-inch traffic signals shall be 67 watt, and shall have a light center length of 2-7/16 inches.

The 12-inch traffic signal head for the "Red" and the stenciled lens shall use a 150 watt traffic signal lamp with a light center length of 3 inches. The remaining 12-inch traffic signal heads shall use 116 watt traffic signal lamps with a light center length of 3 inches. The LED signal module shall fit into the traffic signal housing built to the Equipment and Materials Standards of the Institute of Transportation Engineers (ITE).

5. **Reflectors.** The reflectors shall be either of silvered glass or anodized aluminum or other material that is equal to or exceeds the standards of ITE Technical Report No. 1, latest revision.

6. **Visors.** Visors shall be corrosion-resistant aluminum alloy or polycarbonate resin and shall be of the tunnel type. All signal heads shall contain an anti-sun phantom feature.
7. **Backplates.** Five-inch backplates shall be provided with all signals and shall be aluminum. The backing plates shall be painted dull black. They shall have louvered openings to reduce wind load.
8. **Surface Finish.** All surfaces shall be finished with 2 coats of baked enamel. The finish coat shall be oven-baked and shall meet Federal Specification TT-E-489. The door and visors shall be painted dull black. The polycarbonate units shall have the required color molded in.

B. Programmed Units.

1. **Signal Visibility.** The lens's color position shall be erected and placed in position meeting the position requirements of MUTCD, and the colors of the signal projected shall meet the ITE Transmittance and Chromaticity Standard. The signal unit shall be designed to project the desired signal so it can be seen only by the lane of traffic it controls. The design shall permit the projected image to be seen or veiled from view anywhere in an area up to 15° on either side of the centerline of the projected image. The signal shall not be activated by any other light source such as an adjacent signal. Further, the signal unit shall be capable of showing 2 images at one time from any one signal head, such as a green arrow over the green ball within a definite measured distance from the signal light.
2. **Lens.** The unit shall be made of a high resolution plane incremental lens hermetically sealed within a flat laminant of weather resistant acrylic or approved equal. The lens shall be symmetrical so it can be placed in any position in a 90° arc around its axis without affecting the image projected through it.
3. **Lamps.** The lamps shall be 150 watt, 120 volt A.C., 3-prong stripped sealed beam with built-in reflector and shall have an average life of at least 6,000 hours. The lamp shall be attached to a diffusing element that has a collar with a specular inner surface.
4. **Optical Limiter.** There shall be an optical limiter that projects the signal image to a distance of 900 to 1,200 feet, and provides a veil or mask that can be applied to limit visibility of the image to a specific lane of traffic. The limiter shall be made of heat resistant glass.
5. **Lamp Fixture.** The lamp fixture shall be an indexed ceramic socket, self-aligning, quick-release lamp retainer with a housing and lamp support that is easily accessible. The electrical connection between the case and lamp housing shall be an interlock assembly that disconnects the lampholder when opened. Each signal section shall have a covered terminal block for clip or screw attachment for the lead wires. Concealed No. 18 AWG stranded and coded wire shall be used to interconnect all sections to allow field connection to any section.
6. **Intensity Controller.** Each signal section shall include integral means for regulating its intensity based on background illumination. The lamp intensity

shall be at least 97% of the uncontrolled intensity at 1,000 foot candles, and shall reduce to $15 \pm 2\%$ of the maximum at less than one foot candle. The response shall be proportional and essentially instantaneous to any detectable increase of illumination from darkness to 1,000 footcandles, and damped for any decrease from 1,000 foot candles. The intensity controller shall be comprised of an integrated, directional light-sensing and regulating device interposed between lamp and line wires. It shall be compatible with the 60 Hz input and responsive within the range of 105 to 135 volts. The output may be phase controlled, but the device shall provide a nominal terminal impedance of a 1,200 ohms open circuit and corresponding holding current.

7. **Material Composition.** Die cast aluminum parts shall meet ITE alloy and tensile requirements and have a chromate preparatory treatment. The exterior of the signal case, lamp housing, and mounting flanges shall be furnished with a high quality baked enamel prime and finish paint. The lens holder and case interior shall be optical black. The signal case and lens holder shall be predrilled for backplates and visors. The backplates, visors, and batten plates, shall be painted dull black. The hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather-resistant rubber gaskets. Sheet metal parts including visors and backplates shall meet ITE material requirements, and shall include a chromate preparatory treatment.
8. **Installation.** The signal shall mount to standard 1 1/2-inch fittings. The signal section shall be provided with an adjustable connection that permits incremental tilting from 0° to 10° above or below the horizontal while maintaining a common vertical axis through couplers and mounting. The terminal connection shall permit external adjustment about the mounting axis in 5° increments. The signal shall be mountable with ordinary tools and capable of being serviced with no tools. Attachments such as visors, backplates, or adapters shall conform and readily fasten to existing mounting surfaces without affecting water and light integrity of the signal.

- C. **Beacon Head.** Each beacon head shall consist of a single section traffic signal head conforming to this Section. The fittings shall be standard traffic signal bracket fittings as specified by the manufacturer.

896.09 PEDESTRIAN SIGNALS.

A. Two Piece Pedestrian Signals.

1. Housings.

- a. **Signal Housing.** The incandescent pedestrian signal shall be a 2 section DONT WALK and WALK type. The upper section shall display the DONT WALK symbol and the lower section shall display the WALK message.

The signal shall be dust-free and weather-tight. It shall have molded gaskets between all component parts. All screws, fasteners, and metal parts shall be stainless steel.

The 2 sections shall fit rigidly and securely together without a spacer. All sections shall be identical and interchangeable. The signals shall be de-

signed for mounting on standard 1 1/2-inch signal brackets. The 2 sections shall be fastened together as specified by the manufacturer.

Each rectangular section shall be a one-piece corrosion-resistant aluminum alloy die casting; or a one-piece polycarbonate resin material complete with integrally cast top, bottom, and sides. The housing shall be of substantial thickness and shall be ribbed. Two sets of internal bosses shall be provided in each section for horizontal mounting or terminal strip facilities. Each section shall have an integrally-cast, serrated locking ring which will permit the rotation of the signal head in 5° increments. Two hinge pin openings shall be located on the left side of each housing, and 2 noncorrosive inserts shall be internally located on the right side of each housing.

- b. **Reflector Housing.** The reflector housing shall be a corrosion-resistant aluminum alloy die cast or a polycarbonate resin material. The reflector shall be anodized aluminum or other material that equals or exceeds the standards of ITE Technical Report No. 5, latest revisions.
2. **Lens.** The lens shall be mounted in a continuous neoprene gasket, which completely encompasses the edge of the lens and provides a cushion and positive seal between the lens and the door. The lens and the gasket shall be secured to the door by 4 lens clips.

The legend of the prismatic glass lens shall be fired in, or shall be raised letters on the inside. The polycarbonate lens shall have a smooth surface on the outside and a diffusing surface on the inside. The WALK indication shall be lunar white and the DONT WALK indication shall be Portland orange, both meeting the ITE Standards. All of the lens surface except the letters shall be obscured by an opaque material. When not illuminated, the WALK and DONT WALK messages shall not be visible to pedestrians at the far end of the crosswalk they control. The light source shall be designed and constructed so that in case of an electrical or mechanical failure of the word DONT, the word WALK of the DONT WALK message will also remain dark. The nominal 9-inch rectangular lens shall have letters 3 inches high and the nominal 12-inch rectangular lens shall have letters 4-1/2 inches high. All strokes shall meet ITE Standards.

3. **Lamp.** The lamp socket shall be the prefocused type for holding a traffic signal lamp. This socket shall prevent the lamp from working loose due to vibration. The lamp receptacles shall be weatherproof molded construction and shall withstand, without deterioration, the temperatures encountered during operation.

All traffic signal lamps for use in the 9-inch pedestrian signals shall be 67 watt and shall have a light center length of 2-7/16 inches.

All traffic signal lamps for use in the 12-inch pedestrian signals shall be 150 watt and shall have a light center length of 3 inches.

4. **Visors.** The visors shall be corrosion-resistant aluminum alloy or polycarbonate resin, and shall be the tunnel type. All signal heads shall contain an anti-sun phantom feature.

5. **Surface Finish.** All surfaces shall be finished with 2 coats of oven-baked enamel. The final coat of the door and visors shall be painted dull black. Paint shall meet Federal Specification TT-E-489. Fastening devices shall not be painted. The polycarbonate units shall have the required color molded in.

B. **Programmed Units.** All preceding functional requirements for programmed signal heads and general design requirements for pedestrian heads shall apply for these pedestrian signal heads, with the exception that 75 watt lamps shall be used and lamp dimmers shall not be required.

C. **Single Piece Pedestrian Signals.**

1. **Housings.**

- a. **Signal Housing.** Pedestrian signal heads shall consist of a single piece cast aluminum housing and door, a single piece double parabolic polycarbonate reflector, a single piece glass lens with two color message, a blankout z-crate type visor, appropriate sockets, bulbs, and other related hardware. The design shall present an assembly that has good appearance, easy to maintain, and is energy efficient.

The optical system shall consist of the reflector, lens, bulbs, sockets, and visor. The optical system shall be designed to minimize sun phantom while giving a clear, unmistakable message to the pedestrians using the crosswalk area. Persons outside the crosswalk area shall receive either a limited view or be altogether prohibited from viewing the signal message.

- b. **Reflector Housing.** The reflector shall be formed from a single piece of .25-inch thick textured polycarbonate sheet. The lamp side of the reflector shall be the textured side and shall be reflectorized with vacuum deposited aluminum coating protected by a hard wear resistant coating. A sheet aluminum divider shall be installed between the two message sections to prevent light spill between the sections.
2. **Lamp.** The lamp sockets shall be mounted directly to the aluminum housing to provide a rigid mounting and proper heat sinking. The reflectors shall have appropriate holes top and bottom to provide adequate heat dissipation. With proper air circulation and heat sinks, there shall be no deformation or degradation of the reflector, lens, or other parts of the signal.
3. **Lens.** The lens shall be .187-inch thick tempered glass with the legend and colors applied and bonded to prevent any peeling or cracking. The lens shall be located at least 1.75 inches from the closest glass bulb envelope to prevent heat damage to the lens.
4. **Visors.** The visor shall be fabricated from .040 inch thick black polycarbonate strips to form a geometric grid consisting of 1-inch bisected diamond patterns. The message surface of the lens shall be totally shaded when the sun is more than 22° above horizontal and at least 50% shaded if the sun is 8° or more above horizontal. The visor assembly shall be physically rugged in both material and construction to minimize damage by vandals. The visor assembly shall be fastened to the door with stainless steel screws and shall not protrude beyond the front of the door casting.

5. **Surface Finish.** The signal housing and mounting hardware shall be painted the color as shown in the Contract.

896.10 PEDESTRIAN PUSH BUTTON POST AND BUTTON.

The steel post shall meet AASHTO 270 Grade 36. The post shall be provided with a means to attach the pedestrian push button and sign, and it shall have a post cap.

The push button shall be of tamperproof construction. The assembly shall be weatherproof. It shall be constructed so an electrical shock cannot be received under any weather condition. The housing shall be constructed of die-cast aluminum.

The pedestrian push button shall be raised from or flush with their housings and shall be a minimum of 2 inches in the smallest dimension. The force required to activate the push button shall be no greater than 5 lbf.

896.11 DETECTOR CABINET.

- A. **Cabinet.** The detector amplifiers shall be housed in a gasketed, dustproof, weatherproof cabinet of neat design and appearance made of a satisfactory grade of aluminum or sheet steel. The door shall be of the same material as the housing, mounted on hinges, and shall allow full access to the interior of the cabinet. It shall have a lock with 2 keys provided. The cabinet shall be large enough to provide ample space to house all equipment specified. A satisfactory vent or ventilating device shall be provided at the top of the cabinet to minimize condensation and provide a means of escape for any gases encountered. Each cabinet shall be provided with a mounted lamp receptacle and lamp, a grounded electric outlet, and a suitable shelf for holding detector amplifiers.

Live or hot parts of any electrical equipment inside the cabinet shall be protected. Electrical equipment, terminal facilities, etc., shall be mounted on metal liners (not plywood or other material) and attached to the backwall of the cabinet. The metal liners shall be attached to the backwall of the cabinet. If screws are used to mount the metal liners, the screws shall be tamperproof.

- B. **Connecting Cable.** The connecting cable for the amplifiers shall be laced out of the cabinet wiring harness to permit the amplifier unit to be placed on the shelf within the cabinet. The connecting cable harness shall be flexible to -30°F .
- C. **Cabinet Wiring.** Cabinet wiring shall be neat and firm. Assemblies and panels shall be easily accessible for maintenance purposes. Backwired assemblies of panels shall be mounted and wired to provide accessibility to the backwiring.
- D. **Circuit Breakers.** Two surface-mounted main circuit breakers with no backwire connections shall be provided. One breaker shall carry the load for the detector amplifiers, and the other breaker shall carry the load for the lamp receptacle and the electrical outlet. The breakers shall be single pole, 120/240 volt, 60 Hz., and 15 ampere base load. The breakers shall be conveniently located on one of the inside sidewalls on the cabinet. Each circuit breaker shall be clearly marked with "ON" and "OFF" position, and identified with the load which it is carrying (AMPL. and CONV. OUTLET).
- E. **Terminal Strips.** The detector cabinet terminal strip consisting of sufficient individual point terminal blocks for all external field terminals shall be provided.

Each terminal block shall be a solid (not sectional) one-piece plastic molding with point terminals, with minimum 1/4 inch barriers or of sufficient height to prevent lugs from shorting to adjacent terminals with normal terminal connections. Blocks shall be sized according to load with a minimum size 15 amp signal load, a minimum 50 amp power distribution board, and a minimum 20 amp on all others. The terminal screws shall not extend through the plastic, and the slots shall be of sufficient size to fit the spade-type lugs. The terminal strips shall be individually numbered so there are no duplicate numbers. Numbering shall be on a marker strip or a mounting plate beside each terminal attached to each terminal block. All terminal lugs shall be correctly sized to fit the terminals.

A separate terminal strip interface panel for terminating all amplifier connecting cable leads shall be provided. Each terminal shall be fully insulated with 6-32 binder head screws on the front side. The terminal blocks shall be rated 20 amperes, 300 volts. The number of terminal blocks shall be determined by the total number of required terminations. Terminal strips for equipment AC connections and cabinet ground shall be provided. The equipment ground terminals shall be copper buss-type terminal with set screw-type terminals (not washer head screw-type), or a terminal block of solid (not sectional) one-piece plastic molding with 10-32 size binder head screws not extending through the plastic, and the slots shall be of sufficient size to fit the spade-type lugs. The equipment AC connections shall be made of the copper bus-type terminals with set screw-type terminals (not washer head screw-type).

- F. **Finish.** The cabinet and mounting brackets shall be painted with 2 coats of enamel. Care shall be taken that no gasketing is sealed until the paint is dry. All hinges, locking nuts, etc., shall be free and operate easily without damage to the gasketing after the paint work is completed.

896.12 LIGHTNING PROTECTION.

- A. **Feed Point.** A lightning protection device shall be installed on the feed point incoming lines to prevent lightning surges entering through the wiring from damaging electrical wiring and control equipment in the solid state pretimed or traffic-actuated controller cabinets. The protector shall be a sturdy, weatherproof, service-proven device that immediately drains lightning surges harmlessly to ground. The protector shall be installed on the switch box and shall discharge a surge in a fraction of a second. It shall perform this protective function over and over again, without any maintenance required, possessing the same long-life, value-type characteristics obtained in higher voltage distribution arrestors.

The protector shall be a 2-pole, 3-wire device designed for single-phase 120/240 volt 3-wire grounded neutral service. The protector shall be mounted in the knockout in the switch box. All leads shall be tinned copper No. 14 AWG.

The protector shall be capable of:

1. Limiting the surge voltage to 3 KV peak, while;
2. Conducting surge currents of at least 10 KA with an 8 by 20 microseconds (time to crest by time to second half-crest) waveform; and
3. Recovering to its former state after the surge is over with AC power applied.

The manufacturer of the AC suppressor shall certify that the suppressor meets ANSI C621.1/IEEE, Standard 28, paragraphs 7.1 and 7.6. The suppressor peak voltage shall not exceed 3 KV when tested according to paragraphs 7.3 and 7.5 of the ANSI/IEEE Specification.

The AC line surge protector shall be installed on the load side of the circuit breaker. If the protector should fail and short the circuit, the circuit breaker shall open to give maximum protection. The AC neutral shall have the same protection as the AC load. The arrester leads shall be kept as short as possible. Grounds shall be made directly to the cabinet wall or ground plate as near as possible to the object being grounded. An acceptable arrangement is shown on the Plans.

If the AC power is brought into the cabinet via an underground conduit, a similar arrangement shall be followed as shown on the Plans. If the conduit is metallic, it shall be connected to the ground rod as shown on the Plans.

Connections from the ground rod to the objects inside shall be made with AWG No. 8 (or larger) copper wire.

- B. **Controllers.** A lightning protection device shall be installed at each interconnect wire terminal connection on the cabinet terminal strip as shown on the Plans. A lightning protection device shall also be installed on the incoming power lines to prevent lightning surges entering and damaging electrical wiring and control equipment. The protection device shall do the following:

1. Clamp the surge to as low a voltage as possible, ideally to about twice the peak operating voltage of the circuit being protected.
2. Be capable of conducting a surge current of at least 1,000 amperes at an 8 by 2 microseconds waveform without damage to itself.
3. Be capable of dissipating at least 40 joules of energy without damage to itself.
4. Be capable of suppressing 6 surges in rapid (1 second) succession as described in 1, 2, and 3 above without degradation of performance.

Interconnect line suppressors shall be installed as close as possible to the point where the lines enter the controller cabinet. Surge suppressors packaged in one unit may be utilized in place of the individual arrangement shown on the Plans if the suppressors meet the performance requirements listed above. In either case, the suppressor leads shall be kept as short as possible.

896.13 CONTROLLER CABINET.

- A. **Cabinet Design.** The control cabinet shall meet the requirements of NEMA TS 2 Traffic Controller Assembly with NTCIP Requirements Section 7, except as follows:

1. The steel cabinet shall be painted with 2 coats of aluminum paint meeting Section 852.01A. Care shall be taken that no gasketing is sealed until the paint is dry. All hinges, lock nuts, and any other moving parts, shall be free and operate easily without damage to the gasketing after paint work is complete. Cabinets that are constructed entirely of aluminum need not be painted.

2. The base mounted cabinet shall be sized to provide space for the housing of all equipment specified as well as future coordination equipment. The minimum dimensions of the cabinet shall be 52 inches high, 44 inches wide, and 24 inches deep.
3. The cabinets shall have a cover to block air flow in cold weather. A metal weatherproof cover shall be provided to adequately cover the fan vent assembly and the louver on the door. The cover shall be gasketed and attached to the inside of the cabinet. The cover shall be of the same material as the cabinet and shall be finished the same as the cabinet.
 - a. A weep hole shall be provided in the bottom loop on each end of the cabinet full-size door for water drainage. The cabinet full-size door shall open to the LEFT or RIGHT as shown in the Contract.
 - b. The cabinet shall contain, among others as required, the following items:
 - (1) All items of control equipment specified in these Specifications.
 - (2) A thermostatically-controlled minimum 250watt strip-type finned heater shall be provided and mounted on the full-size door cover and shall have a protective wire-mesh shield installed around the heater. A heavy-duty thermostat, such as a Penn Central A19-BAB-3 or equal shall be used. Power to the fan and to the heater shall be activated by a 3-position toggle switch located on the auxiliary switch panel. The switch shall operate vertically up and down with the up position being FAN (power to the fan shall be on and power to the heater shall be off); the center position being OFF (power to both the fan and the heater shall be off); and the down position being HEATER (power to the heater shall be on and power to the fan shall be off). An electrical 3-prong twist lock-type plug shall be provided between the switch and the heater so the heater can be easily removed. The heater thermostat shall be mounted on the auxiliary switch panel. Connection to the heater shall be made with stranded copper wire having 200°C. insulation and noninsulated, solderless terminals.
 - (3) Duplex receptacle with ground fault interruptor, lamp base with switch. Outlet and lamp to be fused ahead of the main circuit breaker.
 - (4) Fused input for interconnect cable complete with MOV surge protection.
 - (5) Maintenance switches inside the cabinet shall include the following:
 - (a) Stop time control.
 - (b) Timer power.

- (c) Flash.
 - (d) Vehicle detector input for each phase in use and all future phases.
 - (e) Pedestrian input for each phase in use and all future phases.
4. Load switches and flasher with number of sockets as shown in the Contract shall meet the requirements of NEMA TS2 Traffic Controller Assembly with NTCIP Requirements Section 6 and shall include switches and flashers for future phases.
 5. Two radio interference filters and surge protectors, each rated at nominal 120 VAC, 60 Hz., and minimum 30 amp or greater based on load, with one filter and surge protector in the main automatic operation circuit and the other in the main flashing operation circuit.
 6. In addition to the number of solid-state load switch units required to operate the intersection, one spare solid-state load switch unit, separately packaged and marked, shall be provided and stored in the cabinet.
 7. Pushbutton detector test switches shall be provided in the controller cabinet for placing calls for vehicular and pedestrian phases for testing purposes.
 8. The cabinet shall contain 2 surface-mounted main circuit breakers with no back wiring. One breaker shall carry the load during automatic operation and the other breaker shall carry the load during flashing operation. The breakers shall be single pole, 120/240 volt, 60 Hz., and 30 maximum ampere based on the load. If the signal circuit load during automatic operation exceeds 30 amperes, a 3-pole common trip circuit breaker with 30 ampere rating for each pole or a single 60 amp breaker shall be used on that circuit. The signal bus load shall be split and equally divided between the 2 poles. If the flash load exceeds 30 amperes, a 30 ampere 2-pole breaker with split flash shall also be used on that circuit. Each circuit breaker shall be clearly marked with "ON" and "OFF" positions and identified with the load which it is carrying ("AUTO" or "FLASH").

896.14 CONTROLLER.

- A. **General.** The controller shall be a solid state unit and shall have front panel access to display cycle length, offset, and internal timing values. Access to these timing functions shall be by keyboard entry as an integral part of the controller. The controller shall meet NEMA environmental and electrical performance standards. The display shall be a liquid crystal display (LCD) and contain a minimum of 4 lines with 40 characters per line. The display shall have a 16 range adjustment of contrast control and backlighted which automatically turns off 10 minutes after the last key is depressed. The display and keyboard shall be functional over the NEMA temperature range of -34°F. to +165°F.
 1. Hardware for future pedestrian signals shall be provided when shown.
 2. The controller shall be equipped with solid state signal load switching devices meeting current NEMA requirements. Load switches shall be furnished with indicator lights on the front panel.

3. Each controller shall be furnished with a malfunction manager unit (MMU) conforming to NEMA performance standards.
4. The controller shall be furnished with extra feature wiring to provide for remote flashing and each wire shall have its own terminal connection. The flash control circuit shall ensure that remote transfer to flashing from normal stop and go operation occurs during the No. 1 interval in the cycle. When the controller is in flashing condition, the signal switching mechanism shall be inoperative.
5. Load switches for pedestrian indications shall be required when pedestrian indications are shown. The cabinet wiring, load switch sockets, and connection facilities shall be included for pedestrian movements permissible with phasing shown.
6. The Contractor shall provide a technician trained in the operation of the controller to provide training to others at the time of signal activation. The technician shall be available for at least two consecutive days.

B. Pretimed Controller.

1. The controller furnished shall meet current NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements. The plans shall show Type 1 or Type 2 to be used at the intersection.
2. Transfer from one cycle to another shall to another shall occur only at the beginning of the first interval in the signal sequence. Indiscriminate transfer anywhere in the first interval shall not be allowed.
3. Time switches shall be solid state and provide control of selected signal functions. Manual switches for selecting normal controller functions shall be provided in the controller cabinet and be of the type compatible with traffic control function requirements. The manual switches shall have skip day capability and battery backup for continuous operations for at least 72 hours during power failure. When the manual switches require mounting to the cabinet wall, they shall be mounted on the inside of the cabinet door.
4. The controller shall have, as a minimum, the follow features:

3 cycle lengths	1 signal plan
2 splits per dial	preempt capability
3 offsets per dial	2 actuated inputs.

C. Actuated Controller.

1. The controller furnished shall meet current NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements. The plans shall show Type 1 or Type 2 to be used at the intersection.

896.15 LOOP DETECTOR AMPLIFIERS.

The loop detector amplifiers specified shall meet NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements.

The loop detector amplifier shall be self-tuning meeting Section TS 1-15.2.20.2 of NEMA Standards, Part 15.

896.16 RAILROAD PRE-EMPTION.

All equipment and material required for this feature shall be included in the controller cabinet. The rack switch for activating the railroad pre-emption shall normally be closed.

896.17 EMERGENCY VEHICLE PRE-EMPTION.

A. **General.** The controller shall have, when shown in the Contract, a system in which the traffic control signals may be pre-empted by emergency vehicles. The emergency vehicle pre-emption system shall consist of the controller interfacing (if required), phase selectors, optical detectors, detector coupling units, pre-emption indication lights, optical detector cables, mounting and fixtures, and all other miscellaneous items required to complete the emergency vehicle pre-emption system in place and in operation. The indicator light shall not be illuminated until 2 conditions are met:

1. Emergency phase shall be green.
2. Phase selector shall have registered a pre-emption call.

Emitter equipment shall not be provided for this emergency vehicle pre-emption system.

B. Optical Detector.

1. The optical detector shall be a lightweight, weatherproof device capable of sensing and transforming pulsed optical energy into electrical signals usable by the phase selection equipment.
2. The unit shall be high-impact polycarbonate construction with non corrosive hardware.
3. The unit shall be designed for simple mounting at or near an intersection on mast arm, pedestal, pipe, or span wire.
4. The unit shall accept optical signals from two directions and provide a single electrical output signal.
5. The unit shall include a design feature to allow aiming of the two optical sensing inputs for skewed approaches or slight curves.
6. The unit shall have a built-in terminal strip to simplify wiring connections.
7. The unit shall receive power from the phase selector and be operational from 16 to 40 unregulated DC volts.
8. The unit shall be responsive to the optical emitter at a distance of 1800 feet.
9. The unit shall be capable of providing the necessary electrical signal to the phase selector through up to 1,000 feet of optical detector cable.

10. The unit shall employ a replaceable circuit board assembly and photocells to facilitate repair.

C. Optical Detector Cable.

1. Optical system cable shall be tested and certified by the manufacturer of the priority system components that the cable meets or exceeds matched component system performance.
2. The cable must guarantee delivery of the necessary quality signal from the optical detector to the phase selector over a non-spliced distance of 1,000 feet.
3. The cable must guarantee sufficient power to the optical detector over a non-spliced distance of 1,000 feet.
4. The cable must be of durable construction to satisfy the following installation methods:
 - a. Direct burial
 - b. Conduit and mast arm pull
 - c. Exposed overhead (supported by messenger wire)
5. The weight must not exceed .04 lbs./ft.
6. The outside diameter shall not exceed 0.3 inches.
7. The insulation rating must be 600 volts minimum.
8. The temperature rating must be 80°C. minimum.
9. The cable shall have 3 conductors of AWG20 (7 x 28) stranded, individually tinned, copper color coded as follows:
 - a. Orange for deliver of optical detector power (+)
 - b. Blue for optical detector power return (–)
 - c. Yellow for optical detector signal
10. The conductors will be shielded with aluminized polyester and have an AWG20 (7 x 28) stranded and individually tinned drain wire to provide signal integrity and transient protection.
11. The shield wrapping shall have a 20% overlap to ensure shield integrity following conduit and mast arm pulls.

D. Phase Selection Equipment.

1. The priority control system manufacturer shall offer devices to assure interface with electromechanical controllers, solid-state controllers with or with-

out internal priority control capability, and Type 170 controllers with internal priority control software.

2. Phase selector for use with internal preempt controllers.
 - a. Shall be a plug-in, two channel, dual priority device intended to be installed directly into the input file of internal preempt controller equipped with priority phase selection software.
 - b. Shall be powered from AC mains and contain an internal, regulated power supply to power optical detectors.
 - c. Shall be capable of recognizing the following pulse rates as delivered by the optical detectors:
 - (1) $9.639 \pm .119\text{Hz}$ as Frequency I
 - (2) $14.035 \pm .255\text{Hz}$ as Frequency II
 - d. Primary optical detector inputs and power outputs shall be on the card edge. Two additional detector inputs, per channel, shall be provided via a front panel connector.
 - e. An opto-isolated output shall provide the following signals to the card edge:
 - (1) $6.25 \pm .02\text{Hz}$ pulse in response to a low frequency signal
 - (2) A “Steady-On” in response to a high frequency signal
 - f. Shall utilize crystal controlled timing and optical pulse rate recognition circuitry to assure:
 - (1) Accurate optical signal (dual frequencies)
 - (2) Synchronous logic
 - (3) Precise output pulse
 - (4) Accurate call drop-out time
 - g. Shall have six recessed range controls per channel, three per frequency, to independently adjust optical sensitivity.
 - h. Shall have a solid-state “Power-On” indicator.
 - i. Shall have a “Frequency I” and Frequency II” solid-state indicator for each channel which performs as follows:
 - (1) Flashing during call validation
 - (2) Be steady-on when processing a valid call and during test switch operation

- j. Shall have a test switch for each channel to deliver Frequency I or Frequency II signal pulse rates to verify proper function at both optical emitter flash rates, first-come, first-served operation, and Frequency II override capability.
- k. Shall have a selectable call dropout time of 5 seconds (10 seconds optional) -0 to $+2.5\%$.
- l. Shall properly identify a Frequency II demand with any combination of up to 10 high and low priority emitter signals being received simultaneously and asynchronously on either channel.
- m. Shall not exceed the following dimensions:
 - (1) Length (including handle) 7.91 inches.
 - (2) Width 1.11 inches.
 - (3) Height 4.50 inches.

E. **Reliability.** All equipment supplied as part of the optical priority remote traffic control system intended for use in the controller cabinet shall meet the electrical and environmental specifications in the NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements.

F. **Responsibilities.**

- 1. The manufacturer or the manufacturer's representative shall provide quality service before, during, and after installation of the priority control system. The manufacturer or the manufacturer's representative, as consultants to the installer, must provide certified trained technicians having traffic systems industry experience and operational knowledge of priority control systems.
- 2. Before bid/quote activity, the manufacturer or its authorized representative shall conduct field surveys of intersection control equipment to determine the most appropriate phase selection device for each location and to recommend locations for installing optical detectors.
- 3. After an award, the manufacturer or its authorized representative shall be responsible for system documentation including the following:
 - a. Acquire all relevant controller information.
 - b. Determine the number of vehicle phases (greens).
 - c. Determine the desired greens for priority approaches.
 - d. Determine ring configuration of each controller.
 - e. Establish pedestrian phase timing requirements.
 - f. Establish minimum green times for non-priority phases.
 - g. Establish the manipulation method of each controller type.

- h. Supply interface information to installer.
 - i. Assist in system checkout prior to purchaser's acceptance by:
 - (1) Verifying proper installation per recommended interfaces
 - (2) Verifying that optical ranges are properly set
 - (3) Verifying that phase selector timings or controller software timings* are properly set
- *System checkout requirements when using the plug-in version of phase selector must include verification that when two plug-in units are used, the controller must recognize high frequency over low frequency and first-come, first-served. All possible conditions of priority control must be considered. This may require software and/or hardware changes in the traffic controller. Software and programming of these controllers is the responsibility of the purchasing/using agency.
- j. Instruct emergency vehicle operators or their representatives in the operation of the system. Instruction shall include introductory training, periodic training updates, and a leave-behind audio visual self instruction course for on-going training.
 - k. Instruct maintenance personnel in routine maintenance of the system.
 - l. Manufacturer's technical support shall include technical service, design engineering, manufacturing engineering, and research engineering for system development, process management of priority control components, and for in-depth training of system users.

896.18 SPAN WIRE.

The span wire shall be a double galvanized 7 strand steel wire cable not less than 3/8-inch in diameter meeting ASTM A-475.

896.19 STABILIZATION WIRE.

The stabilization wire shall be a double galvanized 7 strand steel wire cable not less than 1/8-inch in diameter meeting ASTM A-475.

896.21 SERVICE POLE.

The Class II wood service pole shall be treated according to Section 846.

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